Data Comm for Business, Inc.

2200LV

VOICE/DATA MULTIPLEXER

USER'S MANUAL

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WARNING

This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference, in which case the user, at his own expense, will be required to take whatever measures may be necessary to correct the interference, including possible disconnection of the equipment.

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1. GENERAL

The DCB 2200LV is a Voice and Data Multiplexer designed to operate over 56 Kbps data channels derived through various facilities, such as through T1 multiplexers. The 2200LV provides four user interfaces (two voice, two data). These four inputs are derived from a multiplexed signal transmitted/received through a standard V.35 type 56Kbps interface. Such 56 Kbps interfaces are provided by separate DSU/CSU devices, or are derived through the local interface of a higher order multiplexer, such as that used to terminate T1 lines.

The 2200LV's advanced design, compact size, and reliability make it an ideal product for most applications requiring the transmission of simultaneous voice and data over a dedicated 56 Kbps digital channel.

2. FEATURES AND BENEFITS

* SIMULTANEOUS VOICE AND DATA OPERATION

The unit operates synchronously through a single 56 Kbps digital channel on the network (aggregate) side, and provides two sync/async data connections and two standard voice telephone type connections on the customer (local) side. The four user interfaces are independent of each other, and may be operated simultaneously through the single digital 56 Kbps output. No blocking or slowdown of data or throughput will occur.

* STANDARD INTERFACE CONNECTORS

The unit contains a 34-pin V.35 type connector for the 56Kbps interface, as well as standard DB-25 connectors for the two data interfaces on the local side. The voice interfaces are terminated through standard RJ-11C type modular jacks. All the customer connections to the 2200LV are made through easily accessible connectors on the rear panel of the unit.

* FLEXIBLE RANGE OF VOICE INTERFACES

The 2200LV provides several varieties of interfaces for its two voice circuits. The units may be provisioned to provide a standard telephone interface for dial-up access (Foreign Exchange-Subscriber, FXS mode), direct connection to a PBX line port or outside telco provided line (Foreign Exchange - Office, FXO mode), or automatic ringdown from telephone to telephone (Private Line Automatic Ringdown, PLAR mode). Each mode is selected by a single switch setting located conveniently on the rear panel of the unit. The 2200LV is compatible with virtually all telephone sets, private automatic branch exchanges (PBX), and telco provided standard telephone lines.

* FLEXIBLE CHOICE OF DATA INTERFACES

The 2200LV offers a wide range of choices for the RS-232C data interfaces on the local side. Each of the two data channels may operate at speeds of 2.4, 4.8, or 9.6 Kbps. The first channel may be optioned to operate at 19.2 Kbps, which then precludes the use of the second channel. Additionally, the channels may be optioned for either sync or async operation, and the user may select either DTE or DCE transmit clock for each channel when in synchronous mode. When in synchronous mode, the 2200LV is independent of both data protocol and format.

* FLEXIBLE 56 KBPS V.35 INTERFACE FOR NETWORK (AGGREGATE) OUTPUT

The 2200LV provides a V.35 aggregate interface towards the network. To facilitate easy connection to a DSU/CSU or higher order multiplexer, this interface is arranged as a DTE type, and is capable of either providing or accepting a transmit data clock.

* INTEGRAL CLOCK GENERATOR

The 2200LV Voice/Data Multiplexer offers two timing modes for synchronization; (Slave) timing, derived from the transmit clock of the V.35 interface, or Internal (Master) timing via an internal crystal oscillator, and provided to the network through the External Transmit Clock pin of the V.35 interface. This offers flexibility by allowing the unit to work in various network configurations, including multi-point private networks.

* EXTENSIVE DIAGNOSTIC CAPABILITIES

The 2200LV offers several test modes for diagnostic purposes. It can perform several types of loopbacks, designed to isolate and identify faults within the entire network. The unit can be placed in a Local Loopback mode, which removes it from the external network, and causes the data and voice channels to be looped back upon themselves. This provides a simple means for testing the 2200LV for proper operation. The Remote Loopback mode sends a unique signal to the far end 2200LV, causing it to

present a loopback back towards the near end. This enables the user to test the digital circuit all the way to the far end 2200LV multiplexer. Simple status lamps on the front of the unit indicate proper operation.

* USE OF VLSI TECHNOLOGY

The 2200LV utilizes Very Large Scale Integration (VLSI) technology to insure high reliability, maximum performance, low power consumption, and compact size. This maximizes reliability and minimizes the need for spares.

* FRONT PANEL LED'S/CONTROL

The front panel holds 10 LED'S and one LOOPBACK switch for quick identification of all status conditions, and convenient selection of test modes.

* COMPACT SIZE

The unit is physically compact, light, and is contained in a housing made of durable plastic, designed to sit on a desktop or in an equipment room. The 2200LV will operate in a broad range of environmental conditions, and requires minimal space and no special power or cooling. Power for the 2200LV is derived from a standard AC outlet.

* EASY INSTALLATION

The 2200LV is designed for easy installation and operation. No trained personnel are needed to install or activate the unit. All connections are of a plug-in, connectorized type, and are made on the rear of the unit. The unit is optioned via two "DIP" switches located on the rear panel. No alignments or adjustments are required.

* LOW POWER CONSUMPTION

The unit has a low power consumption and uses an external wallmount power supply (supplied with unit) which plugs into a standard 120 V, 60 HZ grounded outlet. Due to the low power consumption of the 2200LV, the unit has no cooling fans or moving parts, further enhancing reliability.

* TWO YEAR WARRANTY

The 2200LV Voice/Data Multiplexer has a two year limited warranty which covers all parts and labor. Should service or repair be necessary, contact:

DCB CORP
1989 University Lane, Suite I
Lisle, IL. 60532
(708) 241-0909

3. APPLICATIONS

The 2200LV Voice/Data Multiplexer provides end-to-end connectivity for two voice circuits and two data circuits over a 56 Kbps digital channel, such as provided by a T1 multiplexer, or digital microwave system.

The 2200LV connects to DTE (Data Terminal Equipment) via the two DB-25 (RS-232C) interface connectors mounted on the rear panel of the unit. The DTE can be one of many devices, such as computer mainframes, mini- computers, workstations, CAD/CAM equipment, multiplexers, LAN bridges, video display terminals, video conferencing equipment, high speed printers, etc. Typical applications include connection of terminals at a remote location to a mainframe at a central location, or connections of a remote PC to a LAN. See accompanying diagrams. The 2200LV is a time division multiplexer, whose operation is independent of traffic density or data usage. The 2200LV provides a data connectivity "pipeline" for the two data channels, extended over the 56 Kbps facility.

The 2200LV connects to voice telephone equipment through RJ-11C type (six pin) modular jacks located on the rear panel of the unit. The two voice circuits of the 2200LV provide end-to-end connectivity for two standard telephone circuits with loop signaling (ringing and dialing) control. Typical applications are for remote connection of a telephone to a PBX station circuit (off-premise station), or remote connection to an outside telephone line (off-premise extension). The 2200LV can also be used to support FAX or analog data transmission between two facilities, or can support a point-to-point voice ringdown circuit ("hot line"). When used to connect a phone at a remote location to the PBX at the central location, the 2200LV provides a means for the remote user to have an extension of the PBX, equivalent to those on-site. The use of 16 Kbps Adaptive Differential Pulse Code Modulation (ADPCM) in the 2200LV, provides for a high quality voice connection with minimum transmission delay. The 2200LV contains all the equipment necessary for all voice and signalling applications, including the generators of the ringing and talk battery signals.

The 2200LV can also be used in private, point-to point network applications (see figures), providing access over any derived 56 Kbps synchronous channel. When used in a private, point-to-point application, the unit provides its own clock synchronization via the integral clock generator (Master mode).

4. INSPECTION AND INITIAL SELF TEST

Upon receipt of the equipment, visually inspect it for signs of damage. Immediately report any damage to the transportation company and to the supplier. Then perform the following quick and simple self tests.

1. Before connecting any of the V.35, voice or data cables, plug the male connector at the small end of the cord of the external wallmount transformer (supplied with the unit) into the female receptacle marked POWER on the rear of the 2200LV. Then plug the wallmount transformer into any standard grounded 110 VAC outlet.

2. Observe the front panel LED's (light emitting diodes). The LED marked POWER should be illuminated. All other LEDs should not be lit.

3. Next place the front panel switch marked LOOPBACK in the position marked LOC (left). The LED next to the switch, and the LED marked SYNC should illuminate. This basically indicates normal operation of the unit. Place the LOOPBACK switch back to its normal (center) position.

4. Next connect the unit to the 56 Kbps synchronous channel using a standard V.35 cable. The unit should be functional when connected to an active 56 Kbps channel through the V.35 port. If a valid signal is received by the 2200LV from the 56 Kbps V.35 channel, the LED marked SIG will light. Having done this, the 2200LV is ready for connection to the customer side equipment, per the next section, INSTALLATION.

5. INSTALLATION

Installation of the 2200LV requires no special tools, adjustments, or measurements. Installation of the 2200LV consists of properly setting the two ten position "DIP" switches (S1 and S2) located on the rear panel of the unit, and connecting the voice and data equipment to the connectors on the unit's rear panel. Connection to the 56 Kbps derived channel is accomplished by connecting the unit to the 56 Kbps channel equipment with a V.35 cable. Installation of the voice and data equipment is accomplished by first setting the two DIP switches to their appropriate settings per Section 6 below, and then connecting the data equipment to the 2200LV by connecting an RS-232C type cable, with a 25 pin DB-25 connector, to each of the two connectors, marked RS-232C Data Channel A, and Data Channel B, located on the rear of the unit. The voice equipment is connected by using a standard four or six wire modular cord to connect from the jacks marked Voice Channel A and Voice Channel B on the rear of the unit to the appropriate jacks of the telephone set, PBX , or outside line to which the 2200LV is to be connected. The wiring plan of the modular jacks and of the DB-25 connectors follows the standard conventions. The V.35 interface for the 56 Kbps aggregate signal is provided through a female 34-pin connector, and follows the wiring convention for data terminal equipment (DTE), with the following pin connections:

Transmit Data (TXDA/TXDB)	Pins P & S
Transmit Clock (TCA/TCB)	Pins Y & AA
External Transmit Clock (ETCA/ETCB)	Pins U & W
Receive Data (RXDA/RXDB)	Pins R & T
Receive Clock (RCA/RCB)	Pins V & X
Request to Send (RTS)	Pin C
Data Terminal Ready (DTR)	Pin H
Signal Ground (SGND)	Pin B
Protective Ground (PGND)	Pin A

The DB-25 connectors for the data connections follow the conventions for data communications equipment (DCE), and are wired as follows:

Transmit Data (TxD)	Pin 2
Transmit Clock (TC)	Pin 15
External Transmit Clk (ETC)	Pin 24
Data Terminal Ready (DTR)	Pin 20
Request to Send (RTS)	Pin 4
Receive Data (RxD)	Pin 3

Receive Clock (RC)	Pin 17
Clear to Send (CTS)	Pin 5
Data Set Ready (DSR)	Pin 6
Carrier Detect (CD)	Pin 8
Signal Ground (SG)	Pin 7
Protective Ground (PG)	Pin 1

The modular jacks for the voice telephone connections are of the RJ-11C type, with the following wiring:

Two-wire Pair (Tip & Ring)	Pins 3 & 4

After you make the 56 Kbps aggregate, voice, and data connections, the installation needs only the correct setting of the DIP switches as described in the next section. The POWER LED should be on steady, and the SIG LED should be lit, indicating a successful clock signal is being received through the V.35 interface. If a 2200LV is already connected to the 56 Kbps digital channel at the far end, the SYNC LED should be lit, indicating the reception of a valid signal from the companion 2200LV at the far end of the 56 Kbps digital channel.

6. DIP SWITCH SETTINGS

The 2200LV comes from the factory with all of its DIP switches set as shown in Figure 1. The two DIP switches need to be properly set for each particular user's application. In general, the first DIP switch, S1, controls the operation of the two voice channels and the 56 Kbps channel connection, and the second DIP switch, S2, controls the operation of the two data channels. Both DIP switches need to be set properly for the unit to function correctly (see Figure 1).

The two DIP switches, S1 and S2, are located on the rear panel of the 2200LV. The first DIP switch, S1, controls the two voice channels and the 56 Kbps V.35 interface. Switch S1 is to be set as follows:

S1-1 When ON, puts Voice Channel A in FXS mode. This is the mode that interfaces to the telephone set for ordinary telephone line type applications. In FXS mode, an incoming call will result in the telephone set being rung, and outgoing calls will allow either tone or pulse dialing to be sent from the telephone set to the network.

When OFF, FXS mode is not selected for Voice Channel A.

S1-2 When ON, puts Voice Channel A in FXO mode. This is the mode to be selected when this voice port is to be connected to the line side of a PBX, or connected directly to a standard telephone line. In this mode, the unit accepts ringing signals to indicate an incoming call, and the unit provides on/off-hook and dialing information to the switch or telco. Normally, when one voice port of the 2200LV is optioned for FXO mode, the corresponding voice port on the companion 2200LV unit located at the far end of the telephone line is optioned for FXS mode. In this manner, the 2200LV pair will extend normal telephone operation over the digital 56 Kbps facility.

When OFF, FXO mode is not selected for Voice Channel A.

S1-3 When ON, PLAR mode is selected for Voice Channel A. In PLAR (private line automatic ringdown) mode, a telephone set is connected to the voice port. The voice port of the companion 2200LV located at the far end of the circuit should also be optioned as PLAR, and should have a telephone set attached to its port. When either telephone goes off-hook, the telephone at the far end will ring. This provides a point-to-point "hot line" circuit between the facilities at the two ends of the telephone line.

When OFF, PLAR mode is not selected for Voice Channel A.

S1-4 When ON, FXS mode is selected for Voice Channel B.

When OFF, FXS mode is not selected for Voice Channel B.

S1-5 When ON, FXO mode is selected for Voice Channel B.

When OFF, FXO mode is not selected for Voice Channel B.

S1-6 When ON, PLAR mode is selected for Voice Channel B.

When OFF, PLAR mode is not selected for Voice Channel B.

S1-7 Not Used

S1-8 When ON (up), this switch position selects ASYNC data operation for Data Channel A.

When OFF (down), this switch position selects SYNC data operation for Data Channel A.

S1-9 When ON, this switch position selects ASYNC data operation for Data Channel B.

When OFF, this switch position selects SYNC data operation for Data Channel B.

S1-10 When ON, this switch position selects MASTER timing mode for the 56 Kbps V.35interface. Use master mode at one end when the 2200LV is used over a local channel derived through V.35 cabling or through limited distance modems. In this mode, the 2200LV derives its transmit timing from its own internal clock source, which is passed through to the other end 2200LV unit over the External Transmit Clock pair. When the 2200LV at one end of a circuit is in MASTER mode, the unit at the other end of the circuit must be in SLAVE mode.

When OFF, the 2200LV operates in the SLAVE timing mode. In this position, the timing for both the transmit and receive directions are derived from the transmit and receive clock signals received through the 56 Kbps V.35 channel interface. Use this switch setting for connection of the 2200LV to digital DSU/CSU devices connected to 56 Kbps

private lines, or for connection of the 2200LV to a V.35 port on a higher order multiplexer such as a T1 multiplexer. For this type of connection, the 2200LV units at both ends of the circuit should be in SLAVE mode.

The second DIP switch, S2, controls the operation of the two data channels as follows:

S2-1 When ON, selects an operating baud rate of 2.4 Kbps for Data Channel A.

When OFF, baud rate 2.4 Kbps is not selected for Data Channel A.

S2-2 When ON, selects an operating baud rate of 4.8 Kbps for Data Channel A.

When OFF, baud rate 4.8 Kbps is not selected for Data Channel A.

S2-3 When ON, selects an operating baud rate of 9.6 Kbps for Data Channel A.

When OFF, baud rate 9.6 Kbps is not selected for Data Channel A.

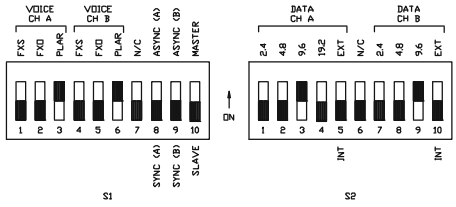

Figure 1. 2200LV Rear Panel DIP Switche

S2-4 When ON, selects an operating baud rate of 19.2 Kbps for Data Channel A. If this switch is in the ON position, Data Channel B becomes inactive.

When OFF, baud rate 19.2 Kbps is not selected for Data Channel A.

S2-5 When ON, this switch selects EXTERNAL TRANSMIT CLOCK for Data Channel A. In this mode, the 2200LV accepts a data clock for this data channel on its ETC lead, Pin 24, of the RS-232C connector.

When OFF, INTERNAL TRANSMIT CLOCK is selected for Data Channel A. In this setting, the 2200LV uses its own clock for the transmit data from the DTE, and provides this clock to the DTE on Pin 15 of the RS-232C connector.

S2-6 Not Used

S2-7 When ON, baud rate 2.4 Kbps is selected for Data Channel B.

When OFF, baud rate 2.4 Kbps is not selected for Data Channel B.

S2-8 When ON, baud rate 4.8 Kbps is selected for Data Channel B.

When OFF, baud rate 4.8 Kbps is not selected for Data Channel B.

S2-9 When ON, baud rate 9.6 Kbps is selected for Data Channel B. Note that 19.2 Kbps is not available for Data Channel B, and selection of 19.2 Kbps for Data Channel A renders Data Channel B inoperative.

When OFF, baud rate 9.6 Kbps is not selected for Data Channel B.

S2-10 When ON, EXTERNAL TRANSMIT CLOCK is selected for Data Channel B.

When OFF, INTERNAL TRANSMIT CLOCK is selected for Data Channel B.

7. FRONT PANEL INDICATORS AND CONTROLS

The following describes the ten green LED indicators located on the front of the unit, and the operation of the front panel rocker switch of the 2200LV.

Front Panel LEDs, as seen left to right:

POWER When lit, this LED indicates that power is applied to the 2200LV unit.

LOOPBACK Located next to the LOOPBACK switch, this LED indicates that the 2200LV is in a loopback mode.

SIG When lit, indicates a valid receive clock signal is being received by the 2200LV through the V.35 interface to the 56 Kbps channel.

SYNC When lit, indicates the 2200LV receiver framing circuit is receiving a valid synchronizing signal from its companion unit at the far end, and is properly aligned to the incoming multiplexed signal.

BUSY (VOICE A) When lit, this LED indicates that a busy (off-hook) condition is being received from the far end for the voice equipment connected to voice channel A. This LED, when not illuminated, indicates the far end voice equipment is idle (on-hook).

BUSY (VOICE B) Same as above, for voice channel B.

XMT (DATA A) When lit, this LED indicates that the 2200LV is receiving a SPACE on its transmit data input (pin 2) from the DTE for Data Channel A, AND the Data Terminal Ready lead (DTR, pin 20) for that channel is asserted.

When not lit, this LED indicates that the 2200 is receiving a MARK from the DTE on its transmit data pin, OR the DTR lead from the DTE is not asserted.

RCV (DATA A) When lit, this LED indicates the 2200LV is sending a SPACE on its receive data output (pin 3) to the DTE, AND Carrier Detect (CD, pin 8) is asserted by the 2200 to the DTE.

When not lit, this LED indicates that the 2200 is sending a MARK to the DTE on the receive data lead, OR Carrier Detect is low (not asserted), indicating a loss of valid signal at the receiver of the 2200LV.

XMT (DATA B) Same as above for Data Channel B.

RCV (DATA B) Same as above for Data Channel B.

The front panel LOOPBACK switch is a rocker type with three positions. The center position is the NORMAL position. When in this position, the 2200LV operates normally, and will transmit and receive voice and data information to and from the far end companion unit. When LOOPBACK is placed in the left position (LOC), the 2200LV is put into its local loopback condition. In this mode, the 2200LVs transmit 56 Kbps information is looped back to its receiver, and an all-ones condition is transmitted to the far end unit. This mode is used for troubleshooting and diagnostics, per Section 10 below. When

LOOPBACK is placed in the right (REM) position, the 2200LV will send a unique loopback signal to the companion 2200LV at the far end, causing it to perform a network loopback back towards the local 2200 (see Section 10). Note that when the LOOPBACK switch is either in the left (LOC) or right (REM) positions, the accompanying LED is lit, indicating a loopback test condition. After 2 minutes, if the switch is left in these positions, the test is terminated and the LED will go off, indicating the test has timed out.

8. VOICE OPERATION

The 2200LV provides two voice channels (ports) derived from the multiplexed 56 Kbps aggregate. Each channel utilizes 16 Kbps Adaptive Differential Pulse Code Modulation (ADPCM), a method of voice compression approved by the major telephone companies as an acceptable means of reducing voice bandwidth. On the transmit (input) side of the voice circuit, the voice signals are received through a

balanced line interface circuit which takes the two-wire bi-directional signal present on the telephone pair, and converts the signal into separate transmit and receive audio signals. The transmit voice signal is then amplified to produce the correct level, and then passed through a bandpass filter. The bandpass filter eliminates any high frequency components of the signal which cause interference with the analog-to-digital conversion process. The resulting voice signal is then sampled at 8000 samples per second, and converted to an eight bit digital representation of the samples. This method of voice digitization, called Pulse Code Modulation, conforms with Bell System standards for the transmission of voice information throughout the network. The digitized voice signal, now represented in 64 Kbps digital form, is then presented to the ADPCM digital signal processor for compression of the signal. The resulting output is a 16 Kbps compressed voice digital signal which is then sent to the multiplexing circuit of the 2200LV for transmission over the aggregate to the companion 2200LV at the far end of the telephone line.

The receive portion of the 2200LV voice circuit provides the inverse functions. The 16 Kbps compressed digital voice signal is presented to the ADPCM processor by the output of the multiplexer circuit. The ADPCM processor then expands (de-compresses) the signal back to a full 64 Kbps voice signal to be acted upon by the digital-to-analog converter. The D-to-A converter then converts the digital signal back to analog, it is passed through a low pass filter to eliminate the effects of the sampling frequency, level adjusted, and then passed through the line interface circuit to be presented to the two-wire telephone pair. This completes the end-to-end process of two-wire to four-wire conversion, digitization, compression, multiplexing and transmission at one end, then reception, demultiplexing, expansion, conversion back to analog, and application to the two-wire telephone interface at the other end.

Signalling (on-hook/off-hook, dialing, ringing) is handled separately from the voice signals in the 2200LV. Signalling information is transmitted from one 2200LV to its companion unit at the far end by means of a dedicated bit within the 56 Kbps multiplexed aggregate signal (one dedicated bit for each of the two voice channels). The signalling information transmitted varies, depending on the operating mode selected for the voice channel. The three operating modes are described below.

FXS - In this mode, the 2200LV provides DC voltage and current ("talk battery") for a local telephone instrument (see Figure 2). By monitoring the presence or absence of current to the telephone instrument, the 2200LV detects whether the phone is idle ("on hook") or busy ("off hook"). This

information is then transmitted to the far end 2200LV, which must be placed in FXO mode. The on-hook or off-hook information is then relayed to the telephone switching equipment by the far end FXO unit. Pulse dialing information is handled in the same way as on-hook/off-hook, since pulse dialing consists of rapid changes in on-hook/off-hook states. Tone dialing consists of audio frequency tones, and is therefore transmitted in digitized form through the voice paths (see discussion above), rather than through the signalling circuits.

When a busy condition is received by a 2200LV in FXS mode from the far end, this represents an incoming call condition. This causes the 2200LV FXS circuit to provide a ringing signal (86 Vrms, 20 Hz) to the telephone set. This ringing signal will continue in accordance to the information received from the far end unit, until the called party answers or the call is abandoned by the calling party. The ringing source within the 2200LV can ring up to two phones per voice channel. The user should be careful to limit the ringer equalvalence applied to each of the two voice channels to 2.0 or less.

CAUTION - Excessive ringing loads on the voice channels can cause damage to the units! Each channel should be connected to the equivalent of two ringers or less.

FXO - The FXO mode is the inverse of the FXS mode (see Figure 2). Indeed, to operate properly a 2200LV optioned for FXS mode must have a 2200LV optioned for FXO mode at the other end, and vice-versa. When in FXO mode, the 2200LV's signalling circuits are conditioned to detect an incoming ringing signal, representing an incoming call, and to provide a DC path (loop closure) to the PBX or central office switch to indicate on-hook/off-hook status. When ringing is detected, the FXO end will send a busy indication to the FXS unit at the far end, thus instructing it to ring its phone. When the far end FXS unit detects an off-hook condition, it sends a busy to the near end

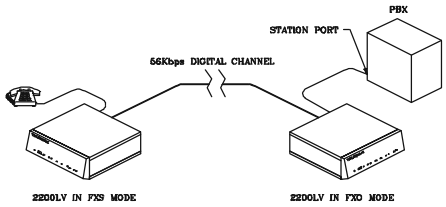

FIGURE 2. FXS/FXO CONFIGURATION

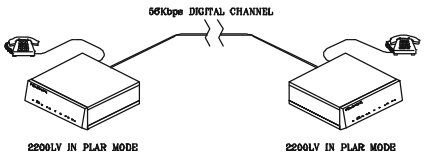

FIGURE 3. PLAR CONFIGURATION

FXO, which then provides an off-hook (loop closure) state to the telephone switching system. In this manner, the FXS/FXO pair together make the two 2200LV units at the two ends of the 56 Kbps line appear "transparent" to the operation of a normal telephone line. Thus the user may establish the same type of telephone services over the circuit derived through the use of the 2200LV multiplexers that he or she could by direct connection over a normal telephone pair. In other words, the 2200LV multiplexer will not interfere, and will pass essentially unchanged, the signalling normally present in a standard telephone line connection (see Figure 3).

PLAR - In this mode, the 2200LV and its far end companion provide a point-to-point "hot line" connection (see Figure 3). Both units, near and far, must be optioned as PLAR circuits. A telephone instrument is connected at each end (Figure 4). When either phone is placed in the off-hook condition, a busy condition is transmitted to the far end 2200LV. This will cause the far end phone to ring. The ringing will continue, at a rate of 2 seconds of ringing, 4 seconds of silence, until the far end party answers, or the near end (calling) party abandons the call attempt. A special feature of the 2200LV prevents an inadvertent continuous ringing condition, by allowing the far end telephone to ring only twenty times. After twenty ringing cycles the 2200LV will cease to ring the phone until the near end hangs up, then reinitiates the call. The ringing load of each channel should be limited to two standard phones (see FXS section).

9. DATA OPERATION

The 2200LV is designed to provide two RS-232C data channels (ports). These ports may be used to provide end-to-end connectivity for synchronous or asynchronous data. The 2200LV data channels may be user configured for speeds of 2.4, 4.8, or 9.6 Kbps. Additionally, one data channel, Data Channel A, may be configured for a transmission speed of 19.2 Kbps. When used in 19.2 Kbps mode (Channel A), Data Channel B is not operative. Transmission of synchronous data and asynchronous data is handled differently by the 2200LV. A description of each is given below.

SYNC DATA - When configured for sync data, the 2200LV data ports act as an end-to-end "pipeline" for the data, independent of format or protocol. In sync mode, data is exchanged with the DTE in accordance with clocks, normally provided by the 2200LV and derived synchronously from the 56 Kbps aggregate output. Specifically, RS-232C data is received by the 2200LV on Pin 2 of the DB-25 connector, and is sent to an elastic storage buffer, of 32 bits size. This data is loaded into the elastic store buffer either in accordance with the Transmit Clock (TC) provided from the 2200LV to the DTE, or in accordance with External Transmit Clock (ETC) provided by the DTE to the 2200LV. This selection is made with a DIP switch option, as discussed previously. When ETC is chosen for the transmit data, it should be noted that the DTE clock must be synchronous with the clock provided by the 2200LV as Receive Clock (RC), to avoid clock slips. No clock slips can occur when TC is used as the transmit data timing source. After the elastic store buffer, data is presented to the multiplexer circuit of the 2200LV for transmission over the 56 Kbps aggregate output. The bandwidth of the aggregate dedicated for each of the two data channels is exactly 9600 bits per second. For this reason, selection of 19,200 bits per second operation of Channel A uses the bandwidth of both channels, precluding the use of Channel B as a separate data channel.

The data received from the 56 Kbps aggregate at the far end is fed from the multiplexer circuit to a "First In, First Out" buffer of 16 bits in the data channel receive circuit. The output of the FIFO is then sent to the DTE in accordance with the Receive Clock (RC) through the RS-232C interface on Pin 3.

ASYNC DATA - Async data is handled in either of two ways by the 2200LV. At speeds of 2.4, 4.8, 9.6, or 19.2 Kbps, the user must select the correct speed setting as in the sync data mode, and must select ASYNC operation (S1-7 and/or S1-8). The user may select one channel as SYNC and one channel as ASYNC if so desired. Again, if Data Channel A is operating at 19.2 Kbps, either sync or async, Data Channel B is inoperative. When operating at 2.4, 4.8, 9.6, or 19.2 Kbps, async data is processed through the microprocessor of the 2200LV. The data is reformatted in a pseudo-packetized format for transmission to the far end, within the 9600 bit per

second bandwidth allowed for each channel. The microprocessor receives and sends the data to and from a UART which provides the timing conversions necessary for the handling of asynchronous data. To operate properly in this mode, the data must be formatted as either EIGHT BIT, NO PARITY or SEVEN BIT WITH PARITY. The sense of the parity does not matter, since the 2200LV will treat the parity bit as a data bit. There is no restriction on the number of stop bits. When operating in this mode, the transmit and receive clocks at the RS-232C interface are not used. The user should be aware that in this mode, the 2200LV will not pass an UNFRAMED BREAK from one end to the other.

Asynchronous data speeds below 2400 bits per second can be handled in any format and any speed by placing the corresponding 2200LV channel in 9.6 Kbps synchronous mode. The data will be transmitted and received through the sync data circuits, and will provide acceptable performance for any standard low speed asynchronous terminal or other device.

CONTROL LEADS - The 2200LV supports several control leads for each RS-232C, in both sync and async mode. The 2200LV will accept as inputs, in addition to data and clock, Data Terminal Ready (DTR), and Request to Send (RTS). The 2200LV will provide, as outputs in addition to data and clocks, Data Set Ready (DSR), Clear to Send (CTS), and Carrier Detect (CD). The 2200LV responds to Request to Send with the assertion (positive voltage) of Clear to Send after a timed delay. The RTS-CTS delays are as follows:

Data Speed	RTS-CTS Delay
2.4 Kbps	8 milliseconds
4.8 Kbps	4 milliseconds
9.6 Kbps	2 milliseconds
19.2 Kbps	1 millisecond

DTR received from the DTE has no effect on the 2200LV, other than the transmit data LEDs on the unit's front panel will illuminate only when DTR is asserted. DSR asserted by the 2200LV indicates that a valid signal is being received at the 56 Kbps input port, and that the unit is not in a local loopback condition. The Carrier Detect (CD) signal asserted by the 2200LV means a valid signal is received by the 2200LV at its aggregate receive port, and the unit may possible be in loopback mode. The receive data LED on the front panel will light only when CD is asserted. Each of the control leads to and from the DTE is a standard unbalanced RS-232C compatible signal.

10. TEST MODES AND MAINTENANCE

The 2200LV Voice/Data Multiplexer provides a wide range of diagnostic capabilities for easing testing, troubleshooting and maintenance. Testing and diagnostic troubleshooting for the 2200LV consists of operation of the various loopback capabilities of the unit, and observance of the LED indicators on the front of the unit to verify correct operation. Additional, more comprehensive testing can be performed with the use of transmission test sets for the voice channels, and/or BERT type data test sets for the data channels. For most situations, however, the simple diagnostics resident within the 2200LV should be adequate.

Testing for the 2200LV is accomplished through the use of the two types of loopbacks available in the unit. The two types of loopbacks used in the 2200LV are LOCAL and REMOTE. By utilizing these various loopbacks, a user at one end of a 56 Kbps digital connection can successfully test both the near

end 2200LV unit, the far end unit, and the digital circuit in between.

The first diagnostic of use in the 2200LV is the LOCAL LOOPBACK. The LOCAL LOOPBACK is used to test the unit at the location where the test is being performed (near end). To perform the LOCAL LOOPBACK test, place the LOOPBACK switch on the front of the unit in the LOC position. The LED next to the switch should illuminate. This indicates that the 56 Kbps output of the 2200LV is looped back to its receiver input. During this test condition, an all ones pattern is transmitted to the network. When in LOCAL LOOPBACK, observe the states of the SIG and SYNC LEDs. If these LEDs are both lit, proper operation of the local 2200LV is indicated. While in local loopback mode, the data channels can be tested
with a BERT test set if desired. The data transmitted on each of the two data ports will be received back on the same port. Testing of the voice channels in LOCAL LOOPBACK is not possible, since the channels are looped back upon themselves. After completion of the LOCAL LOOPBACK test, place the LOOPBACK switch back its normal (center) position. The LED next to the switch should turn off. Should the LOOPBACK switch remain in the LOC position, the LOCAL LOOPBACK condition will be automatically terminated after two minutes, and the LED will turn off, indicating the test has ended. To reestablish the loopback, put the switch in the normal position, then back to LOC.

To test the 2200LV at the far end, place the LOOPBACK switch in the REM position. Again, the LED next to the switch should light. In this mode, the near end 2200LV will transmit a special loopback code through its 56 Kbps aggregate to the far end unit. Upon receipt of the special loopback by the far end unit, the far end unit will provide a loopback towards the network, and hence towards the testing end. This loopback signal from the far end includes a special pattern used to assist in determining proper transmission through the system. When both units and the transmission line are operating properly, the near end unit will have its SYNC and SIG lights on. This condition, during the REMOTE LOOPBACK test, indicates correct operation of both 2200LV units, and of the 56 Kbps digital channel in between. Verification tests can be run by sending BERT tests through the data channels. Again, this test will terminate automatically after two minutes, if the LOOPBACK switch is left in the REM position.

If the REMOTE LOOPBACK test described above is not successful, the problem is either in the remote 2200LV unit, or in the 56 Kbps digital channel in between. The LOCAL LOOBACK test can be performed on the far end unit to determine if that unit is functioning properly. If the far end unit passes the LOCAL LOOPBACK test, the problem is likely to be in the digital channel between the two locations.

By utilizing these two types of loopbacks, the cause of a problem should be easily identified. Should it be determined that a fault exists in one of the 2200LV units, it should be replaced. The units are not field repairable, and should be returned to DCB for repair, if necessary. If technical assistance is required, contact the DCB Customer Service Department by calling (708) 241-0909.

11. DCB CORPORATION LIMITED WARRANTY

DCB Corporation warrants this product against defects in material or workmanship under normal operating conditions for a period of 2 (two) years from the date of purchase. This warranty covers the product during the warranty period when in the possession of the original purchaser only. In the event service is required, the product must be delivered within the warranty period (prior authorization required), transportation prepaid to DCB CORP together with evidence of date and place of original owner's purchase. You will be responsible for removal and installation of the product. In all cases, the DCB warranty is limited to the repair or replacement of defective units.

LIMITATION OF WARRANTY: DCB will repair or replace, at no charge, units found to be defective during the two year warranty period. Failures attributable to improper use, storage, or maintenance of the product are not covered by this warranty. DCB's liability is limited to the repair or replacement of defective units. This warranty shall not apply to manuals or accessories.

DCB CORPORATION AND ITS REPRESENTATIVES OR ITS AGENTS SHALL IN NO EVENT BE LIABLE FOR ANY GENERAL, INDIRECT, OR CONSEQUENTIAL DAMAGES ARISING OUT OF OR CAUSED BY THE USE OF OR THE INABILITY TO USE ANY DCB PRODUCT. THIS WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND OF ALL OTHER LIABILITIES ON THE PART OF DCB. ALL OTHER WARRANTIES, INCLUDING THE WARRANTY OF MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED BY DCB AND ITS REPRESENTATIVES.

12. REPAIR AND RETURN PROCEDURES

If a unit is in need of repair, call DCB for a Return Material Authorization (RMA) number and return the defective unit, freight prepaid, along with a brief description of the problem to:

DCB CORP
1989 University Lane, Suite I
Lisle IL. 60532
Attn: Repair and Return Dept.

As specified in our warranty, DCB will repair and return the unit at no charge to the customer, providing that the warranty period has not expired, and that the unit has not been damaged through misuse.

If a critical out-of-service situation exists, a replacement unit can be obtained within 24 hours in most cases. (A purchase order number will be required to insure return of the replacement unit.)

Out-of-warranty service or replacement is also available. Contact DCB or its authorized representative for more information.

13. SPECIFICATIONS

Data Interfaces

User Interface: RS-232C, supported through DB-25 connector

Data Speeds: 2.4, 4.8, 9.6, or 19.2 (channel A only) Kbps, for synchronous or asynchronous data, user selectable. Asynchronous speeds below 2.4 Kbps can be accommodated by operating in 9.6 Kbps synchronous mode.

Supported Leads: Transmit Data, Receive Data, Transmit Clock (sync), External Transmit Clock (sync), Receive Clock (sync), RTS, CTS, DTR, DSR, and CD.

RTS to CTS Delays: 8 milliseconds at 2,400 bps.
4 milliseconds at 4,800 bps.
2 milliseconds at 9,600 bps.
1 millisecond at 19,200 bps.

Input Elastic Buffer: 32 bits

Transmit Data Timing (synchronous operation): Provided by DCE (TC), or DTE (ETC), user selectable.

Synchronous Data Format: Any

Asynchronous Data Format: 8 Bit, no parity, or 7 Bit with parity (odd or even) for speeds of 2.4 Kbps or greater. Speeds below 2.4 Kbps may be accommodated in any format by operating the channel in synchronous mode.

Voice Interfaces

User Interfaces: Two-wire (single pair, Tip and Ring), supported through RJ-11C (six-wire) type modular jack

Signalling Types: Loop start FXS (interface to telephone set), loop start FXO (interface to station line or telephone line originating from central office switch or PBX), or PLAR (hot line between two phones)

Ringing Signal: 86 Vrms, 20 Hz, two standard phones per channel maximum

Longitudinal Balance: Greater than 45 dB, 200 - 4000 Hz

Input (Transmit) Level: O dBm (600 ohms) at 1000 Hz produces a 0 dBm0 digital reference signal

Output (Receive) Level: A 0 dBm0 received digital reference signal (1000 Hz) produces a -6 dBm +/- 1 dB output (600 ohms) at Tip and Ring

Signal to Noise Ratio: Greater than 20 dB at O dBm0

Idle Noise: Less than 30 dBrnC

Frequency Response: Relative to 1000 Hz level, +/- 2 dB, 300 - 3000 Hz

Dialing: Supports tone (DTMF) and pulse dialing

Overvoltage Protection: Per FCC Part 68 requirements

V.35 Interface

Aggregate Interface: Synchronous, 56 Kbps, V.35

Connector: 34 Pin, female, standard V.35 type

Clocks: Transmit Clock (slave mode), External Transmit Clock (master mode), Receive Clock

General

Number of Voice Channels (Ports): 2

Voice Type: 16 Kbps ADPCM, derived from mu-law companded 8-bit PCM, 8000 Hz sample rate

Number of Data Channels (Ports): 2

Data Type: Synchronous or asynchronous, RS-232C compatible

Aggregate: 56 Kbps, V.35

Transmit Timing Source: V.35 Transmit Clock (Slave), or internal crystal timing source (Master)

Diagnostics: Local Loopback and Remote Loopback

Regulatory: Meets or exceeds applicable requirements of FCC Part 15 for Class A computing devices, and UL requirements for AC powered equipment and equipment connected to the telephone network.

Physical

External Power Supply: 90 to 140 VAC, 60 Hz, UL listed source

Power Dissipation: Less than 4 watts (internal) idle, less than 10 watts when voice circuits busy

Environment: 0 to 50 degrees C, up to 95% RH non-condensing

Size: 3.5 x 10.8 x 11 in. (H x W x D)

Weight: 4.5 lbs

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

For further information, contact:

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807 Pioneer
Champaign, IL. 61820

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FAX 217-352-0350

NOTES